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Use of investigations in lower respiratory tract infection in the community: a European survey

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ABSTRACT: A questionnaire survey was performed on the use of investigations and their impact on treatment of adult lower respiratory tract infection in the community. Data on the management of 2,056 such infections were obtained simultaneously from general practitioners in France, Germany, Italy, Spain and the UK.

Diagnostic tests were only performed in 29% of cases. Chest radiographs were performed most frequently (22%), followed by peripheral blood white cell count (15%) and microbiological examination of sputum (7%), with major differences being found in the frequency of these tests both by clinical diagnosis and country. A change in initial antibiotic therapy was made in 12% of cases, with use of investigation being significantly linked to such changes.

Second- and third-line antibiotics were significantly different to first-line therapy, with macrolides the most frequently prescribed second-line and quinolones the most frequently prescribed third-line antibiotics.

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Lower respiratory tract infections (LRTIs) are amongst the commonest illnesses of mankind, with an estimated annual incidence of 40 per 1,000 adults [1]. Of those seeking medical attention, most are managed in the community by general practitioners (GPs). Antibiotics are the mainstay of therapy, the use of which may be directed by the results of simple investigations. How frequently such investigations are performed in the management of LRTIs in the community, whether there are national differences in the use of such investigations, and the impact of their results on therapy, in particular antibiotic prescription, is not known. A multinational European survey of the management of LRTIs was carried out, and the results regarding the use of investigations and second- and third-line antibiotic therapy are presented here.

Methods

The design of the survey, data collection methods and methods of statistical analysis are detailed in the accompanying paper on first-line antibiotic therapy [2]. Briefly, between December 8, 1993, and January 24, 1994, a standardized questionnaire was administered to a random, but representative sample of GPs in France, Germany, Italy, Spain and the UK, identified by the "method of quotas" [2]. Information was sought about the last three or four adults seen, for whom the GP considered the diagnosis to be community-acquired LRTI. The criteria for this diagnosis were left to the judgement of the GP, since the aim of the study was to investigate normal practice, rather than altering practice by specifying definitions. The time since patient consultation was not recorded, but since the study was performed in the winter the delay between consultation and study is likely to have been short.

In addition to questions about patient demographics, symptoms, clinical signs and antibiotic therapy, the questionnaire also sought the GP's presumptive clinical diagnosis. Four clinical categories were provided: community-acquired pneumonia (CAP); acute bronchitis (AB); exacerbation of chronic bronchitis (ECB); and viral LRTI, including influenza (VRTI). Again the criteria for each category were left to the judgement of the GP, but will be analysed as part of a future paper.

Details about whether a chest radiograph (CXR), peripheral blood white cell count (WCC) and sputum sample (SPUTUM) had been obtained were recorded. For those patients where a CXR had been obtained, the GP was asked to give details of the result. Neither CXR reports nor the original CXRs were examined, and no attempt was made to investigate causative pathogens or to record the results of haematological or microbiological investigations. For each antibiotic prescribed, the influence (if any) of the above investigations on the prescription was sought.

Statistical analysis compared percentages by two-way and multiway frequency analysis, and by means of χ^2, analysis of variance and t-test [3]. A difference was considered as significant if p-value was less than 0.05.

Table 1. – Relationship between number of tests performed and country

Number of tests	Proportion of cases according to country %					
	France	Germany	Italy	Spain	UK	All
Any test	21	43	24	36	18	29
One	11	24	17	21	11	17
Two	7	15	5	12	5	9
Three	3	4	1	3	2	3

Table 2. – Relationship between the number of tests performed and clinical diagnosis

Number of tests	Proportion of cases according to clinical diagnosis %				
	CAP	AB	ECB	VRTI	All
Any test	58	29	33	16	29
One	29	15	19	10	17
Two	20	6	11	6	9
Three	8	1	4	0.5	3

CAP: community-acquired pneumonia; AB: acute bronchitis; ECB: exacerbation of chronic bronchitis; VRTI: viral lower respiratory tract infection, including influenza.

Table 3. – The relationship between individual investigations and country

Country	Proportion of cases in which each investigation was performed %			
	CXR	WCC	SPUTUM	Any test
France	18	14	3	21
Germany	27	27	12	43
Italy	21	7	4	24
Spain	31	18	6	36
UK	13	8	6	18
All	22	15	7	29

CXR: chest radiograph; WCC: peripheral blood leucocyte count; SPUTUM: microbiological examination of sputum.

Table 4. – The relationship between individual investigations and clinical diagnosis

Clinical diagnosis	Proportion of cases in which each investigation was performed %			
	CXR	WCC	SPUTUM	Any test
CAP	53	29	12	57
AB	15	10	5	22
ECB	24	17	10	33
VRTI	9	10	4	16
All	22	15	7	29

For definitions see legends to tables 2 and 3.

Results

Details of GPs, patient demographics, diagnostic groups and first-line antibiotics are given in the accompanying paper. Briefly, data concerning 2,056 episodes of LRTI (France 369; Germany 484; Italy 360; Spain 363; UK 480) were gathered, of which 369 (18%) were CAP, 679 (33%) AB, 397 (19%) ECB and 605 (29%) VRTI.

Overall, no tests were performed in 71% of episodes, with one or more diagnostic tests being performed in 29% of episodes. There were significant differences in the number of tests performed both according to country ($p<0.0001$) and clinical diagnosis ($p<0.0001$), as shown in tables 1 and 2.

CXRs were performed most frequently (22%) followed by WCC (15%) and SPUTUM (7%), with major differences in the frequency of each test between countries ($p<0.0001$) and clinical diagnosis ($p<0.0001$) as shown in tables 3 and 4. All tests were performed more frequently when the clinical diagnosis was CAP and, with the exception of CXRs in Spain, all tests were performed more frequently in Germany. CXRs were performed least in the UK (13%), WCC (7%) in Italy, and SPUTUM (3%) in France, with all three being performed least for VRTI.

The frequency of abnormalities detected on CXR was high, with 71% overall showing abnormalities. There was a significant difference between countries ranging from 63 out of 75 (84%) CXRs showing abnormalities in Italy to 84 out of 131 (64%) in Germany ($p<0.001$), and between diagnoses ranging from 171 out of 195 (88%) in CAP to 42 out of 102 (41%) in AB ($p<0.0001$) (tables 5 and 6). Changes consistent with the presence of pneumonia were the most frequent radiographic abnormalities, being found in 35% of all those in which CXRs were performed, ranging from 30% of cases in which CXRs were performed in Germany and the UK to 44% in France, and to 69% of those with CAP to 7% of those with AB. Pleural effusions were identified seldom, with no difference in frequency between diagnoses, but ranging from 1% in Spain to 6% in the UK. The frequency of other abnormalities was more variable, ranging from 11% in the UK to 25% in Italy, and from 7% in CAP to 29% in ECB and VRTI. There was a relationship between the recording of clinical signs on examination of the chest to both the frequency of performance of CXR and the frequency of radiographic abnormalities, with a higher frequency of both in those with focal chest signs ($p<0.0001$) (table 7).

A change in initial therapy was made in 12% of patients, with most changes in the UK (17%), France (16%) and Italy (12%), and least in Germany (8%) and Spain (6%) (table 8). Such a change was more frequent where the

Table 5. – Radiographic findings according to country of origin

Feature	Proportion of cases showing this radiographic feature %					
	France	Germany	Italy	Spain	UK	All
Pneumonia	44	30	32	38	30	35
Pleural effusion	5	4	3	1	6	3
Other abnormality	20	17	25	15	11	18
? Abnormal	9	13	24	14	19	15
Normal	9	34	9	29	20	23
Not known	13	2	7	3	4	6

diagnosis was CAP (21%) or ECB (14%) than for AB (9%) or VRTI (7%) (table 9). The commonest reason for a change in therapy was poor response to initial antibiotics (tables 8 and 9), and whilst overall there was no difference in the frequency of change according to initial antibiotic type (p=0.09) when the reason for change was initial antibiotic failure, changes occurred more often when the initial antibiotic was a first generation cephalosporin, penicillin or penicillin plus beta-lactamase inhibitor, compared to other antibiotics (p<0.05).

Second-line antibiotics were prescribed to 199 (10%) and third-line to only 27 (1%) patients. Compared to first-line antibiotics, there was a significant difference in the patterns of second-line (p<0.0001) and third-line (p<0.005) antibiotic prescription, with macrolides the most frequently prescribed second-line and quinolones the most frequently prescribed third-line antibiotics (table 10). Performance of investigations was significantly related to failure of first-line therapy (table 11), and influenced second- and third-line more than first-line antibiotic prescription (table 12). In view of the small numbers receiving second- and third-line therapy, a further breakdown of these figures (*e.g.* by country) has not been performed. In general, the influence of tests on first-line therapy was in proportion to the number of tests performed, with CXR having the biggest influence and tests having most impact on prescribing in Germany and least in the UK (table 13).

Table 6. – Radiographic findings according to clinical diagnosis

Feature	Proportion of cases showing this radiographic feature %				
	CAP	AB	ECB	VRTI	All
Pneumonia	69	7	8	11	35
Pleural effusion	3	3	4	3	3
Other abnormality	7	21	29	29	18
? Abnormal	9	10	35	14	15
Normal	8	48	21	36	23
Not known	4	11	3	7	6

For definitions see legend to table 2.

Table 7. – Chest radiograph (CXR) abnormalities related to physical signs on examination of the chest

Chest sign	Frequency of CXRs %	Proportion abnormal* %
Normal (n=1,017)	22	69
Focal (n=468)	32	84
Diffuse (n=336)	11	58
Unknown (n=170)	14	32
Total (n=1,991)	22	71

*: p<0.0001 by χ^2 test comparing proportion abnormal for each chest sign

Table 9. – Reasons for failure of first-line antibiotic according to clinical diagnosis

Clinical diagnosis	Proportion of cases with this reason for antibiotic failure %				
	Clinical failure	Allergy	GI intolerance	Others	All
CAP	14	1.5	1.2	3.8	21
AB	7	0.3	0.8	0.8	9
ECB	10	0.5	1.1	2.6	14
VRTI	5	0.2	1.3	0.7	7
All	9	0.6	1.1	1.7	12

GI: gastrointestinal. For definitions see legend to table 2.

Table 10. – Frequency of each antibiotic group in second- and third-line compared to first-line therapy (all clinical groups from all countries)

	Proportion of cases receiving each antibiotic group %										
Line	PE	PI	C1	C2	C3	MA	CY	QU	SU	AM	Other
First	26	9	9	3	11	21	10	7	3	0.2	1
Second	10	8	13	3	16	23	4	17	4	0	3.5
Third	4	7	19	4	15	15	7	30	0	0	0

PE: penicillins; PI: aminopenicillin + β-lactamase inhibitor; C1: first generation cephalosporin; C2: second generation cephalosporin; C3: third generation cephalosporin; MA: macrolide; CY: tetracycline; QU: quinolone; SU: sulphonamide; AM: aminoglycoside.

Table 11. – Number of tests performed related to failure of first-line antibiotic therapy

	Number of tests performed %			
	Any	one	two	three
Failure of 1st antibiotic	53	26	20	8
Success of 1st antibiotic	29	17	9	3

p<0.0001 by χ^2 test comparing success and failure groups.

Table 12. – Influence of tests on antibiotic prescription

Test	First-line antibiotic (n=1,778) %	Second-line antibiotic (n=199) %	Third-line antibiotic (n=27) %
CXR	7.8	22.0	30**
WCC	4.0	6.6	11#
SPUTUM	2.7	6.6	7.7*

#: NS; *: p<0.02; **: p<0.0001 by χ^2 test for frequency of influence of each test between groups. For definitions see legend to table 3.

Table 8. – Reasons for failure of first-line antibiotic according to country

Country	Proportion of cases with this reason for antibiotic failure %				
	Clinical failure	Allergy	Gastrointestinal intolerance	Others	All
France	11	0.6	1.5	3.1	16
Germany	6	0.5	1.1	0.8	8
Italy	7	0.3	0	4.5	12
Spain	3	0	1.9	0.3	6
UK	15	1.1	0.9	0.5	17
All	9	0.6	1.1	1.7	12

Table 13. – Influence of individual investigation on first-line antibiotic prescription in each country

Country	Proportion of prescriptions influenced by each investigation %		
	CXR	WCC	SPUTUM
France	3.4	1.2	0.9
Germany	17.6	14.5	7.5
Italy	5.4	0.6	1.5
Spain	11.9	3.8	1.9
UK	2.6	0.5	1.6
All	8.0	4.1	2.7

For definitions see legend to table 3.

Discussion

Little information exists about the frequency of use and type of investigations used in the management of patients with lower respiratory tract infection (LRTI) in the community. This is the first study to investigate these factors using a standardized methodology simultaneously applied in five European countries. Since it is difficult to design studies on the management of conditions in the community which do not, by their nature, alter the practice under study, a retrospective approach was used in this study. Nevertheless, the data generated has limitations imposed by the design of the study and the contents of the questionnaire used. The accuracy of the data is dependent on the memory of the GP, in view of the retrospective format of the questionnaire. Whilst figures quoted may not be absolutely precise, trends and comparisons between groups are likely to be valuable in view of the standard design of the study. It was not possible to determine when, in relation to the evolution of the illness and the number of GP visits, investigations were performed, or to determine precisely why investigations were performed. Furthermore, it was not possible to corroborate the reported radiographic abnormalities or to determine whether changes in therapy made as a result of investigations were, in fact, appropriate. However, despite these reservations, conclusions can be made about the number of investigations performed in relation to the country studied and the clinical diagnosis, and also their impact on treatment.

Whilst most patients were managed without any investigations, as expected, it is perhaps surprising that more than a quarter did indeed have investigations performed. This figure may be artificially high due to recall bias, with GPs perhaps more likely to remember patients for whom investigations were requested. Investigations were performed most often in Germany, with nearly 50% of all patients having one or more performed, and least often in the UK, where less than one in five were investigated. This trend was the same both for number of investigations and for each of the individual investigations, CXR, WCC and SPUTUM, with the exception of the slight excess of CXRs in Spain. Possible explanations for these differences are the different health care systems in each country, ease of access to investigation, and differences in the perceived value of the results of investigations.

Investigations were most frequent where the clinical diagnosis was CAP, followed by ECB, with least investigations in those with AB or VRTI. CXRs were the most frequent type of investigation (22%) followed by WCC (15%) and SPUTUM (7%), and each was performed most frequently in those with CAP, with CXRs being performed in over 50% of such cases. There are few published data with which to compare these figures, but in a study of acute bronchitis from The Netherlands, the rates of CXR, WCC and SPUTUM were 4.8, 1.6 and <1%, respectively, considerably lower than average figures in our study [4]. This could represent a national difference in general practice, similar to those seen between the five countries included in the current study, but may also be influenced by differences in the methods used between the two studies.

Chest radiograph abnormalities were found approximately in proportion to the rate of performance of CXRs, with abnormalities found most often in those with CAP followed by ECB and least in AB and VRTI, regardless of country. Changes on the CXR consistent with a diagnosis of pneumonia were most frequent in CAP, with <12% showing such changes in other diagnostic groups. This partly validates the diagnosis in the CAP group, although it is not possible, as stated above, to know how much the CXR findings influenced the stated clinical diagnosis. Compared to hospital practice, where radiographic changes are necessary for a diagnosis of pneumonia, in the community, it is usually diagnosed on clinical criteria, which may be supported by CXR abnormalities in some cases. In a study from Norway [5], radiographic pneumonia was found in 32% of those with clinical pneumonia, 6% of those with acute bronchitis and 9% of those with asthma/chronic obstructive pulmonary disease (COPD) - not dissimilar to the present figures. Other studies have found radiographic pneumonia in 41% [6] and 57% [7] of patients with "severe" chest infection using different definitions for severity, whilst a study of patients with LRTI found such changes in only 7% [1]. A UK study, which used the presence of focal signs on examination of the chest to make a clinical diagnosis of CAP in patients with LRTI, found radiographic pneumonia in 39% compared to only 2% in those with no such signs [8], and this was confirmed in a subsequent study with changes consistent with infection in 21% of those with focal chest signs compared to 7% of those with no such signs [9]. A relationship between focal chest signs and radiographic abnormalities has been confirmed in the present study, with 84% of such patients having radiographic abnormalities compared to 69% of those with no chest signs. The higher frequency of CXR abnormality in both groups in the current study may be due to the fact that the patients were selected for CXR by the GP, whereas in the above studies all patients had a CXR performed.

While the reasons for performance of tests cannot be assessed in detail from this study, there was a relationship with failure of first-line antibiotic therapy; at least some of the tests will have been performed for this reason. The results of a study of GP use of sputum microbiology from the UK have suggested that failure of initial antibiotic therapy was the main reason for GPs to request this test, accounting for 52% of requests, with only 14% of such tests being performed at first presentation with respiratory infection [10].

The use of tests had some influence on prescription of first-line antibiotics, but a much greater influence on second- and third-line prescriptions, with CXR having a much greater influence than either WCC or SPUTUM results, whichever country is studied. Investigations had most impact on prescriptions in the countries (*e.g.* Germany) where they were performed most. The lack of value of sputum examination at first presentation for LRTI has been suggested in other studies, with sputum culture being positive in only 8% of 166 samples from patients with clinical pneumonia [8], and 7% of 198 samples from patients with LRTI [9].

A change in antibiotic therapy was made in a surprisingly small proportion of patients, with second-line antibiotics given to 10% and third-line to <2% of cases. This compares favourably with UK data, which suggest that one quarter of patients with LRTI return to the GP for a second consultation, with 19% of the original cohort receiving a second antibiotic [1]. In the current study, treatment modification occurred most frequently in patients in France and the UK, being >15% of cases in each country, usually as a result of treatment failure. The reasons for the higher frequency of failure of first-line therapy when first generation cephalosporins, penicillins or penicillins plus beta-lactamase inhibitor were used as first-line therapy cannot be assessed from the present study, but the poor response of respiratory tract pathogens to oral first generation cephalosporins, *Mycoplasma pneumoniae* infection and penicillin-resistance in *Streptococcus pneumoniae* are possible explanations. It appears paradoxical at first sight that antibiotic modification was required more often in those conditions with a high likelihood of bacterial aetiology (*i.e.* CAP and ECB) compared to those (*i.e.* AB and VRTI) which are usually considered to be of viral origin [11] and, hence, unlikely to be altered by antibiotic therapy. This may reflect the self-limiting nature of many of the latter illnesses, compared to more severe illness in those with CAP or ECB.

The pattern of second- and third-line antibiotics differed from first-line therapy. Since the numbers are small, especially for those receiving third-line therapy, conclusions are difficult to draw, but the predominance of macrolides as second-line therapy is probably appropriate, since aminopenicillins were the most frequently used first-line therapy.

In conclusion, this study has confirmed that most lower respiratory tract infections are managed by general practitioners without use of diagnostic tests, and that where such tests are performed a chest radiograph is the most frequent. However, major differences in the use of common investigations and their impact on therapy exist between European countries. Further research is required to determine the reasons for the use of investigations and the reasons for these national differences before any recommendations about the performance of such tests in the community can be given.

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